Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2015

Technology and Design

Assessment Unit AS 1

assessing

Product Design and Practice

[AV111]

MONDAY 8 JUNE, MORNING

MARK SCHEME

General Marking Instructions

These mark schemes are intended to ensure that the AS/A2 examinations are marked consistently and fairly. The mark schemes provide examiners with an indication of the nature and range of candidate responses likely to be worthy of credit. They also set out the criteria which they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these general marking instructions which apply to all papers.

Quality of candidates' responses

In marking the examination papers, examiners will be looking for a quality of response reflecting the level of maturity which may reasonably be expected of 17- and 18-year-olds which is the age at which the majority of candidates sit their AS/A2 examinations.

Flexibility in marking

The mark schemes which accompany the specimen examination papers are not intended to be totally prescriptive. For many questions, there may be a number of equally legitimate responses and different methods by which the candidates may achieve good marks. No mark scheme can cover all the answers which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner for the paper concerned.

Positive marking

Examiners are encouraged to be positive in their marking, giving appropriate credit for valid responses rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected for 17- and 18-year-old candidates. Conversely, marks should only be awarded for valid responses and not given for an attempt which is completely incorrect and inappropriate.

Types of mark schemes

Mark schemes for questions which required candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication. These questions are indicated on the cover of the examination paper.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

Quality of written communication

Quality of written communication is taken into account in assessing candidates' responses to all questions that require them to respond in extended written form. These questions are marked on the basis of levels of response.

Levels of response

Questions requiring extended written answers are marked in terms of levels of response. In deciding which mark within a particular level to award any response, examiners are expected to use their professional judgement. The following guidance is provided to assist examiners.

Threshold performance: Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.

Intermediate performance: Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.

High performance: Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

In all cases, correct alternative responses will be given full credit.

AVAILABLE MARKS

Section A

1 **(i)** Plasticity – It is important because when a force is applied to create the profile of the sink it is essential that the material does not crack or break and maintains its shape. [2]

(ii) Any **two** main properties of stainless steel from the following:
- The oxide film prevents rusting.
- Shiny attractive metal.
- Good strength to weight ratio. [2]

(iii) The term tolerance relates to the + or – measurement of dimensions that is acceptable when manufacturing a component. [2] 6

2 **(i)** E.g. hockey sticks –
Any **two** specific properties of ash from the following:
- Tough.
- Flexible.
- Good resistance to shock. [2]

Any **one** working characteristic for ash from the following:
- Ash machines well, it is suitable for nailing, screwing and gluing.
- It takes stains and polishes well. [1]

(ii) Any **one** specific application for oak – e.g. furniture. [1]

Any **one** main working characteristic from the following:
- Open grained.
- Machines well. [1] 5

3 **(i)** Any **two** reasons why acrylic is used from the following:
- Good transparency levels for glasses.
- A lightweight material.
- Resistant to cleaning products. [2]

(ii) The manufacturer would use statistics to determine the number of glasses to be selected for testing (e.g. 1 in 10 components). [2] 4

4 **(i)** The difference between injection moulding and blow moulding –
Injection moulding involves plastic being injected into a mould whereas blow moulding involves air been blown into a section of extruded plastic tube. [1]

(ii) Suitable sketch of the vacuum forming process to include the heater, sheet, mould and vacuum. [2]
Description of the clamping, heating, air evacuation and cooling. [2] [4] 5

			AVAILABLE MARKS
5	**(i)**	Any **two** main characteristics of rapid prototyping from the following: • Like a 3D printer instead of ink it uses a solid material and 'grows' a three dimensional product. • Produces detailed products at relatively low cost. • Relatively quick process compared to other 3 dimensional processes. [2]	
	(ii)	Any **two** main characteristics of Quality Control from the following: • This involves inspecting, sampling and testing. • Quality Control checks to see if standards are being achieved. • Quality Control is part of the achievement of Quality Assurance. [2]	4
6	**(i)**	Any **two** main characteristics associated with mass production from the following: • Continuous or very large number of items produced. • Only small or little variation to meet client requirements can be achieved. • Cheaper unit cost compared to other methods. • Less skilled labour required. [2]	
	(ii)	Any **two** main characteristics associated with just-in-time from the following: • Only buy materials and components as and when you need them. • JIT removes the need for stockpiles of resources. • Saves on money and space. [2]	

For a response not worthy of credit.	[0]
Limited explanation and use of English grammar.	[1]
Clear and coherent explanation using good English grammar.	[2]

Quality of written communication [2] 6

7	**(i)**	The British Standards is the National Standard for the UK which is an agreed technical specification or other precise information for a product. [2]	
	(ii)	E.g. Children's toys Any **two** different ways from the following: • Strong bright primary colours. • Tonal colours. • Harmonious or contrasting colours. • Colour association. [2]	4

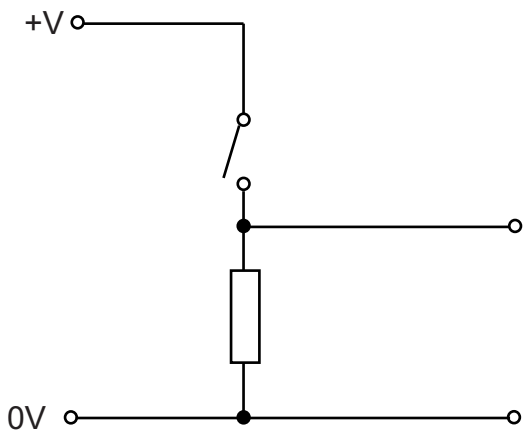
			AVAILABLE MARKS
8	**(i)**	Sustainability: The ability to maintain our quality of life at its present level. From this comes the idea that the current generation of people should not damage the environment in ways which will threaten the quality of life and the environment for future generations. [2]	
	(ii)	E.g. Computers One main scientific advancement – Development in chip technology and processing The influence this has had on its design – This has resulted in a considerable increase in capacity and a large reduction in size. [2]	
	(iii)	E.g. Exercise Equipment One main change in culture – Exercising and personal fitness The influence this has had on its design – Developments of domestic exercising devices or programmes and computers exercising games or CDs and apps on phones. [2]	6
		Section A	**40**

Section B

AVAILABLE MARKS

9 **(a)** **(i)** X is a **NOT** gate and Y is an **OR** gate. [2]

(ii)



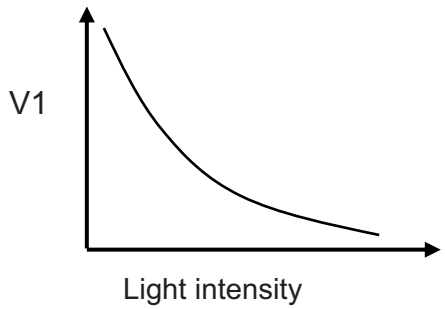
[2]

(iii) Truth table

A	B	C	F	Q
0	0	0	1	1
1	0	0	1	1
0	1	0	1	1
1	1	0	1	1
0	0	1	1	1
1	0	1	1	1
0	1	1	0	1
1	1	1	0	0

[3]

(b) **(i)** V1 decreases as light increases.



[3]

(ii) V1 = 6 × 140/162 = 5.19 V [2]

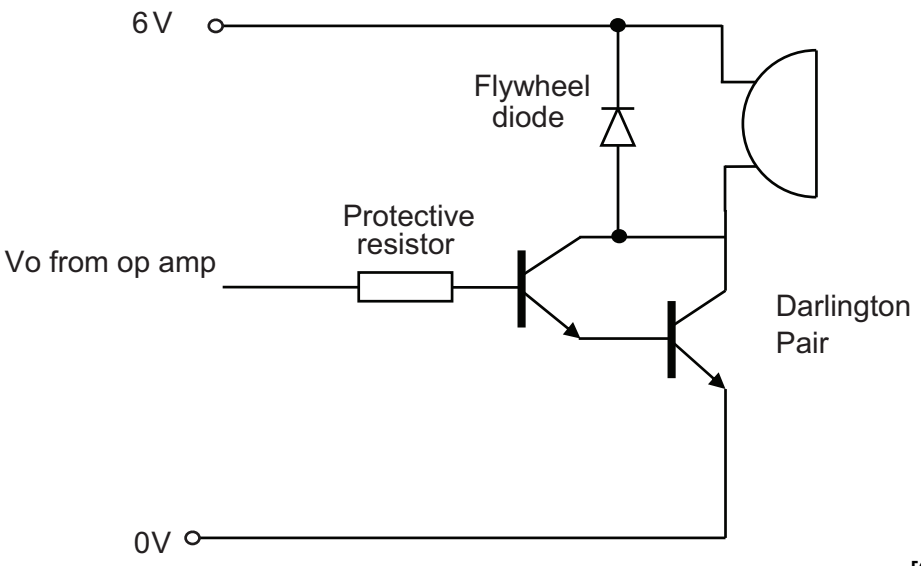
(iii) The LED will be illuminated. Since R3 and R4 act as a voltage divider V2 will be 3 volts. V1 has previously been calculated at 5.19 volts therefore V1 is greater than V2. The output of the op amp will be high causing the LED to be illuminated. [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

(c) (i) Power dissipated = 6 × 0.45 = 2.7 watts. [2]

(ii)



[3]

AVAILABLE MARKS

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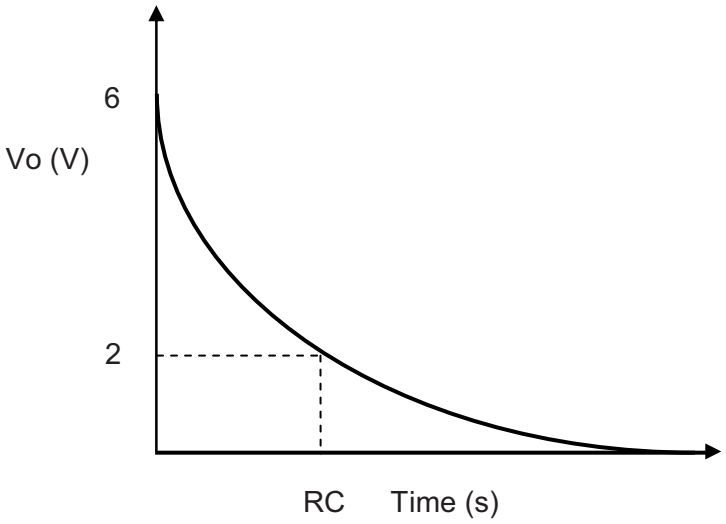
AVAILABLE MARKS

10 (a) (i) The time constant is the time taken for the voltage across the capacitor to reach approx. 2/3 of the supply voltage when charging. [1]

(ii) 0.12 × 100 = 12 seconds. [1]

(iii)

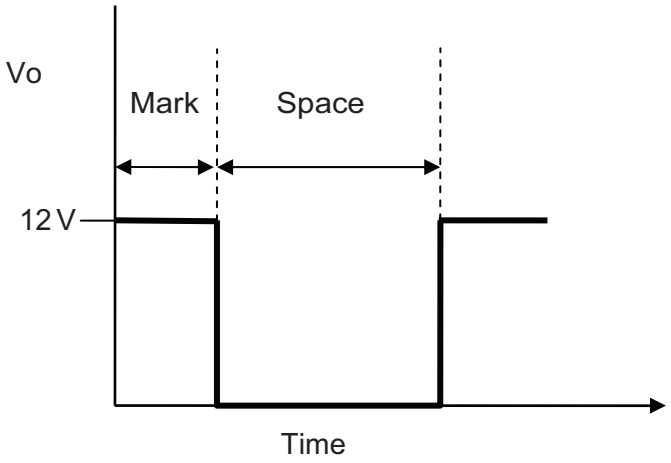


[3]

(b) (i) The frequency/time period of Vo will change. [1]

(ii) The output from the system shown can be considered as on/off because the output from a 555 astable will switch between two states, (12 V and 0 V). The frequency of these two states can be changed but the levels will remain constant. [2]

(iii)



[3]

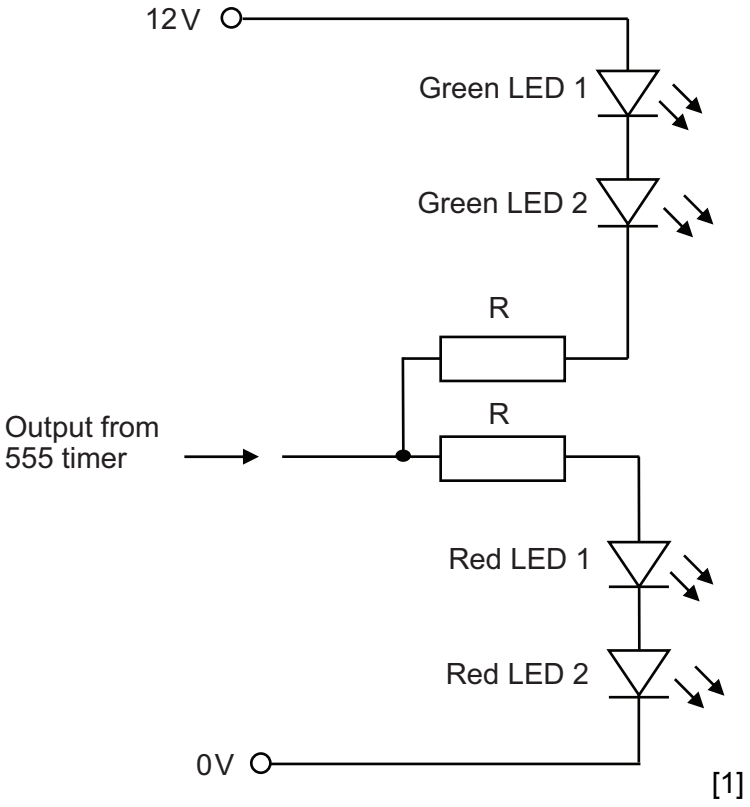
(iv) frequency $= 1.44/(1 \times 10^3 + 4.4 \times 10^3)100 \times 10^{-9}$
$= 2.667\,\text{kHz}$
Time period $= 0.375\,\text{ms}$ [3]

(c) (i) The resistance of the resistor R could be 5% higher or 5% lower than its stated value. If the resistance of the resistor R was 5% lower the current flowing through the LEDs would exceed the optimum value. This means that the LEDs would not be operating under optimum conditions and damage to the LEDs could potentially result. [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

(ii)



[1]

Description of red LEDs on. [1]

Description of green LEDs on. [1] [3]

Section B **40**

AVAILABLE MARKS

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Section C

AVAILABLE MARKS

11 (a) (i) Gear **D** and gear **H** rotate in the same direction as each other. [1]

(ii) Annotated sketch outlining a suitable cotter pin. [1]
Cotter pin integrating with shaft and gear A. [1] [2]

(iii) A–C = 120/120 = 1 [1]
D–E = 90/60 = 1.5 [1]
F–G = 50/100 = 0.5 [1]
Tot VR = 1 × 1.5 × 0.5 = 0.75 [1] [4]

(iv) VR = G–H = 0
H–I = 90/60 = 1.5 [1]

Wormwheel 80
80 × 1.5 = 120 [1]
Eff = 118/120 × 100% = 98% [1] [3]

(v) F–G = 50/100 = 0.5
H–I = 90/60 = 1.5
Tot VR = 0.5 × 1.5 = 0.75 [1]
OS = IS/VR
OS at I = 375/0.75 = 500 rev/min [1]
500 at I/5 at K = 100
Reduction required of VR 100
Wormwheel needs to be replaced with one having 100 teeth [1] [3]

(vi) Gear B transmits rotary motion from gear A through to gear C enabling them to rotate in the same direction. Gear B does not have any effect on the velocity ratio of the overall system [2]

or other suitable answer.

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

(b) A suitable answer could involve the use of a parallel linkage attached to a rack and pinion. A rotation of Shaft Z will move a rack connected to a parallel linkage.

Marks awarded as follows:

Method used to raise/lower the platform. [2]
Method used to convert the rotary motion of Shaft Z to drive the raising and lowering system employed. [2] [4]

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12 (a) (i) The activation method at A is a diaphragm/low air pressure. [1]

(ii) The activation method at C is a solenoid. [1]

(iii) Method used to produce the following:
Air bleed at A [2]
or connection between A and B [1]
Connection to cylinder X [1] [4]
See sample solution
or other suitable solution

(iv) Method used to produce the following:
C and D connection [1]
Self return solution [1]
Connection of 3PVs to 5PV [1]
Connection to cylinder Y [1] [4]
See sample solution
or other suitable solution

(v) Method used to produce the following:
E enabling cylinder Z to outstroke/piping arrangement of 5PV [1]
Time delay automatic return [2]
Connection to cylinder Z [1] [4]
See sample solution
or other suitable solution

(b) Safety issue – Unsecured pipes could disconnect from the connecting ports and whip around having the potential to cause an injury. Unsecured components could be dangerous as they can move quickly to an unwanted area and cause injury. [1]

Procedure – The operator should make sure that all pipes are secured in the ports and that all components are secured down before air is connected to enable the system to be used [1] [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

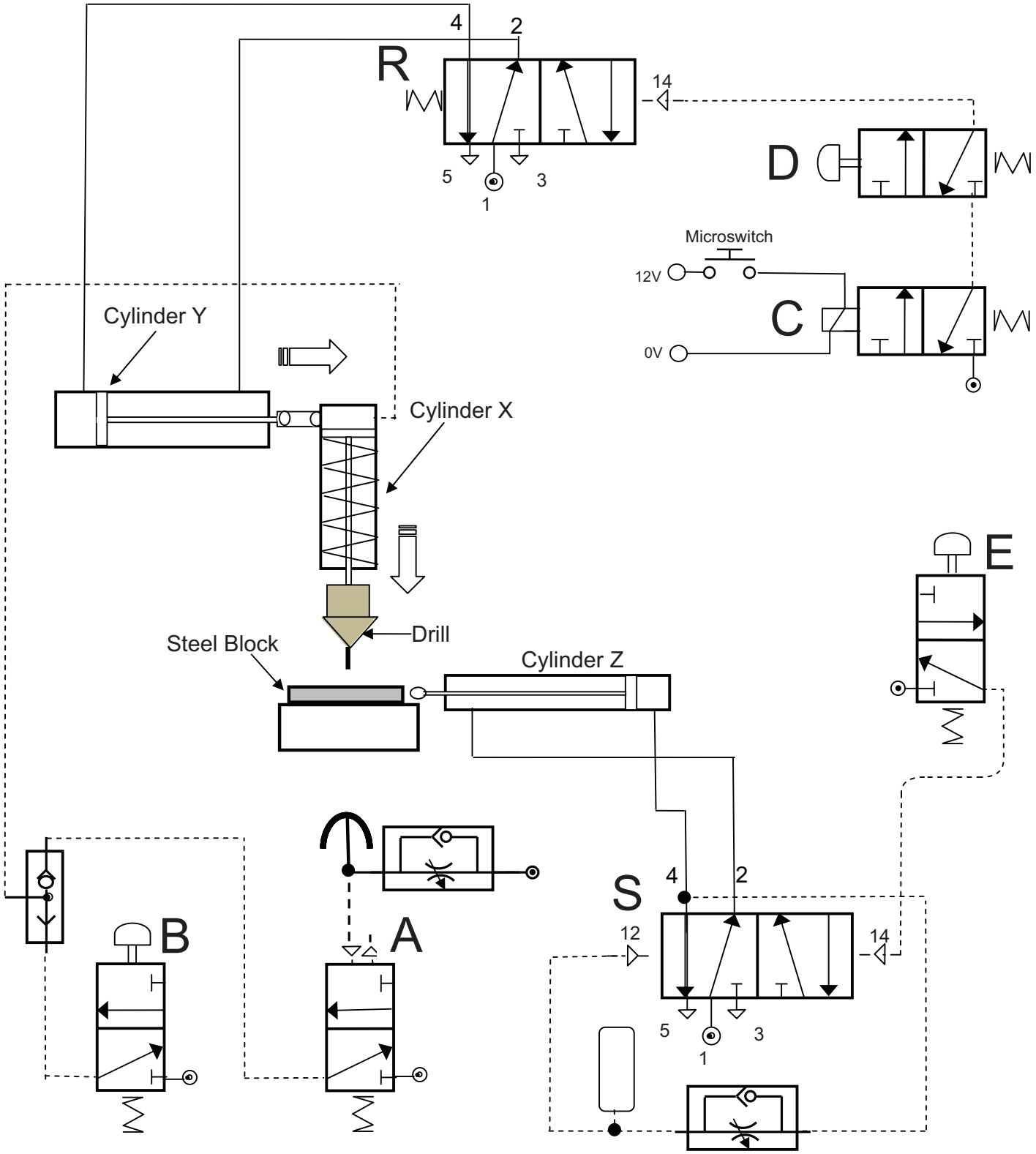
(c) Please assume $\pi = 3.14$.
$F = P \times A$

Piston rod area = $3.14 \times 3 \times 3 = 28.26\,mm^2$ [1]
$28.26 \times 0.5 = 14.13\,N$ [1]
$75.87 + 14.13 = 90\,N$ [1] [3]
Ans = 90 N outstroke force

Section C **40**

AVAILABLE MARKS

20



Answer Fig. 12

Section D

Product Design

AVAILABLE MARKS

13 (a) (i) The target audience that this product has been designed for would be teenagers or young adults. [1]

(ii) Any **two** different marketing constraints from the following;
- Climatic conditions of the region and seasonal restrictions.
- Constraints with regards to space (inner city marketing).
- Constraints with regards to income. [2]

(iii) Any **two** main criteria that would influence the selection of the material to be used for the bats from the following :
- Tough.
- Good strength to weight ratio.
- Suitable for moulding. [2]

(iv) Any **two** forms of anthropometric data from the following:
- Hand measurements to determine handle shape and size of the bats.
- Human reach to determine tether length and height of the product.
- Lift capability of adults to determine the overall weight of the product. [2]

(v) Any two different ways in which the designer has incorporated ergonomics from the following:
- Size of the ball and bat to engage hand to eye co-ordination.
- Height of the unit to enable a range of users to engage with the product.
- Length of the nylon tether to accommodate user reach. [2]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

(vi) Any **two** main reasons why folded boxboard is the material used from the following:
- Produces a strong durable board for the package.
- Cost effective material.
- Suitable for printing graphics on. [2]

(b) (i) Solution could be based on a red bordered pictogram containing a plan view of the game with two coloured double arrows indicating the limit for each player's position during a game. A red tick could also be used to indicate that this is an acceptable space for the player to operate within.

Level of response not worthy of credit.	[0]
A vague sketch. Difficulty in determining if the design is appropriate and conveys the stated information.	[1]
The sketch is limited. The design conveys aspects of the stated information.	[2] or [3]
Detailed and appropriate sketch. The design clearly conveys all aspects of the stated information.	[4]

[4]

(ii) A solution could be based on an ergonomically shaped strap with a sliding clip to accommodate different wrist sizes. One end of the strap could be inserted through a hole on the end of the bat and closed (similar to that used on a cable tie) to allow freedom of movement.

AVAILABLE MARKS

Level of response not worthy of credit.	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate and enables the user to quickly secure the bat to their wrist.	[1]
Both the sketch and annotation are limited. Some aspects of the design are appropriate and the user could secure the bat to their wrist.	[2] or [3]
Detailed annotated sketch. The design is appropriate for the product and enables the user to quickly secure the bat to their wrist.	[4]

[4] 20

AVAILABLE MARKS

14 (a) (i) A survey is a data collection tool used to gather information about individuals which may be factual or it might aim to collect the opinions of people participating in the survey. [1]

(ii) Any **two** main advantages of using a questionnaire from the following:
- Question responses can be highly structured and easily coded.
- Inexpensive way to cover large area.
- Representative sample can be achieved. [2]

(b) Any **three** letters in the acronym SCAMPER –

1. Substitute
Think about replacing part of the problem, product or process with something else. By looking for replacements you can often come up with new ideas.

2. Combine
Think about combining two or more parts of your problem to create a different product.

3. Adapt
Think about adapting an existing idea or part idea in order to solve a design problem.

4. Modify
Consider many of the attributes of the thing you're working on and change them if necessary. Attributes include: size, shape, dimensions, texture and colour.

5. Put to another use
Modify the intention of the subject and suggest new and unusual purposes.

6. Eliminate
Remove elements of your subject which will simplify and reduce the design to its core functionality.

7. Reverse
Change the direction or orientation. Turn it upside-down, inside-out, or make it go backwards.

[3]

(c) Laser cutting.
The design will be drawn up using an appropriate drawing or graphics package. Sheet will be positioned in the bed of the machine. The laser cutter works by directing a very powerful laser beam, at a precise focal length, onto the sheet. The material will be cut leaving an edge with a high quality surface. [3]

Quality of written communication [1]

For a response not worthy of credit.	[0]
Clear and coherent explanation using good English grammar.	[1]

(d) Any **two** main characteristics associated with a Flow Process chart from the following:

- The Flow Process chart provides a visual representation of the steps in a process.
- It uses a range of symbols to communicate the entire process.
- Constructing a Flow Process chart improves communication, and can build team understanding. [2]

(e) (i) An appropriate design for the knife slots to prevent the knives from scoring the sides of the slots.

Solution could be based on three replaceable injection moulded plastic inserts. The inserts would match the slot and be machined to be press fitted.

Level of response not worthy of credit	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is appropriate and prevents the knives from scoring the sides of the slots.	[1]
Both the sketch and annotation are limited. Some aspects of the design are appropriate to prevent the knives from scoring the sides of the slots.	[2] or [3]
Detailed annotated sketch. The design is appropriate for the product and prevents the knives from scoring the sides of the slots.	[4]

[4]

(ii) Solution could be based on a press fitted injected moulded cover.

Level of response not worthy of credit	[0]
A vague sketch lacking detail and appropriate annotation. Difficulty in determining if the design is viable, easily removed and prevents young children from accessing the knives.	[1]
Both the sketch and annotation are limited. Some aspects of the design are viable, easily removed and prevents young children from accessing the knives.	[2] or [3]
Detailed annotated sketch. The design is viable, easily removed and prevents young children from accessing the knives.	[4]

[4]

Section D

Total

AVAILABLE MARKS

20

40

80